STUDY OF CLINICAL EFFECTIVENESS OF PRESSURE-RELIEVING GARMENT

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EXTENDED ABSTRACT

Key Words: foam properties, garment design, interface pressure reduction, pressure sores

1. INTRODUCTION

Pressure sores are localized areas of tissue necrosis which may be caused by prolonged high pressure, lack of blood supply, and impaired lymphatic drainage [1,2]. Wheelchair-bound individuals with disability, the elderly, and prolonged sitting individuals are at high risk of developing pressure sores [3-5]. Currently, pressure relieving material mainly includes foam, gel/fluid pad or air-filled cell to relieve, redistribute or reduce pressure for prevention of pressure sores [6]. Apatsidis's research found that polyurethane (PU) foam is most suitable in the peak pressure reduction and redistribution [7].

2. OBJECTIVES

(1) To investigate the effect of physical and mechanical properties of foam on the reduction of interface pressure for relief of pressure sores (2) To design a pressure-relieving garment with the selected foam and study its clinical effectiveness.

3. METHODOLOGY

8 types of polyurethane (PU) foams: 4 different thicknesses (1.27, 2.54, 3.81, 5.08 cm) of 2 different density (13.5 ± 3 kg/m 3 and 30.5 ± 3 kg/m 3) were selected for measurement. The foam stiffness was determined using Instron tensile tester (Model 4411). The interface pressure was measured using CONFORMat®-Pressure Measurement System (Tekscan, Inc., USA) at sitting and lying positions. The effect of foam properties (thickness / density / stiffness) on interface pressure reduction were analyzed using Pearson Correlation analysis and ANOVA method. The confounding effect of BMI and body positions were analyzed using ANOVA method. Pressure reduction effect among these 8 types of foams was determined. A garment with the selected foam was designed to reduce sitting acquired pressure for wheelchair users. Totally 25 wheelchair users were recruited and the interface peak pressure, temperature and humidity were assessed when they sat on a standard wheelchair with and without the pressure-relieving garment. The reduction of interface pressure, temperature, humidity were analyzed using Paired T-test.

4. RESULTS

It was found that the foam density is the main factor on the pressure reduction effect ($0.28<R<0.86$, $P<0.05$). BMI and body position were confounding factors and demonstrated cross-over effect on the pressure reduction effect. Furtherly, PU foam at thickness 2.54–3.81 cm of 13.5 ±3 kg/m 3 and K2 and K3 moduli demonstrated higher pressure reduction. In wear trial, the garment reduced the interface pressure at 70.2% underneath the ischial tuberosity, and the garment decreased the humidity over 5.1% and did not induce significant interface temperature change (P>0.05). The garment could provide the wheelchair user more comfortable.

5. CONCLUSION

The foam density was the main factor on the pressure reduction effect. BMI and body position demonstrated cross-over effects on the pressure reduction effect. Low density Polyurethane foam with thickness less than 4 cm & appropriate K2 and K3 moduli are more suitable for pressure reduction. The pressure-relieving garment designed with this foam was effective in reducing sitting acquired pressure for wheelchair users and it is worthwhile for relief of pressure sores.

6. REFERENCES

1. N. Reddy, T. Krouskop and P. Newell, Biomechanics of a lymphatic vessel, *Journal of Vascular Research*, 1975, 12, 261-278.
2. National Pressure Ulcer Advisory Panel, European pressure ulcer advisory panel & national pressure ulcer advisory, *prevention and treatment of pressure ulcers: Quick reference guide*, Washington, 2009.
3. R. Aissaoui et al., Analysis of pressure distribution at the body-seat interface in able-bodied and paraplegic subjects using a deformable active contour algorithm, *Medical Engineering & Physics*, 2001, 23, 359-367.
4. D. Smith, Pressure ulcers in the nursing home, *Annals of Internal Medicine*, 1995, 123, 433-442.
5. G.M. Yarkony, Pressure ulcers-a review, *Archives of Physical Medicine and Rehabilitation*, 1994, 75, 908-917.
6. S.L. Garber, Wheelchair cushions – a historical review, *American Journal of Occupational Therapy*, 1985, 39(7), 453-459.
7. D.P. Apatsidis, S.E. Solomonidis, and S.M. Michael, Pressure distribution at the seating interface of custom-molded wheelchair seats: Effect of various materials, *Archives of Physical Medicine and Rehabilitation*, 2002, 83(8), 1151-1156.